

CLAIMS

What is claimed is:

1. An apparatus in an internal combustion engine having a
2 rotatable element that eccentrically moves at least one roller
lifter to alter the phasing of the at least one roller lifter
4 engaging with a cam, the apparatus comprising:

a constraining mechanism having at least one end member and
6 at least two interior members connected to said at least one end
member; and

8 at least one stationary block which slidably receives a one
of said at least one end member allowing fore-and-aft movement
10 of said constraining mechanism in cooperation with a first
roller lifter in a first direction;

12 wherein said at least two interior members engage said
first roller lifter to allow movement of said first roller
14 lifter in a second direction to said first direction such that
when the rotatable element eccentrically moves said first roller
16 lifter, said first roller lifter is prevented from rotating
about a longitudinal axis of said first roller lifter.

2. The apparatus according to claim 1 wherein said at
2 least two interior members each engage a one of two flat
surfaces of said first roller lifter to allow said movement in
4 said second direction.

3. The apparatus according to claim 2 wherein said at
2 least two interior members are substantially parallel to each
other, and said two flat surfaces of said first roller lifter
4 are substantially parallel to each other.

4. The apparatus according to claim 1 wherein said first
2 direction and said second direction range from being
substantially perpendicular to each other to an orientation not
4 too close to parallel such that the at least one roller lifter
becomes constrained from moving eccentrically while being
6 prevented from rotating about said longitudinal axis.

5. The apparatus according to claim 1 further comprising:
2 a second roller lifter aligned with said first roller
lifter; and
4 an additional pair of interior members connected to said at
least one end member, wherein said additional pair of interior
6 members each engage a one of two flat surfaces of said second
roller lifter to allow movement of said second roller lifter in
8 said second direction, and said second roller lifter is
prevented from rotating about a longitudinal axis of said second
10 roller lifter.

6. The apparatus according to claim 5 wherein said
2 additional pair of interior members are substantially parallel
to each other, and said two flat surfaces of said second roller
4 lifter are substantially parallel to each other.

7. The apparatus according to claim 1 wherein said at
2 least two interior members each have a slot, and further wherein
said first roller lifter has two locating pins extending from
4 opposite sides of said first roller lifter and perpendicular to
said longitudinal axis of said first roller lifter, wherein each
6 of said two locating pins engages with a one of said slots of
said at least two interior members to allow said movement of
8 said first roller lifter in said second direction.

8. The apparatus according to claim 1 wherein each of
2 said at least two interior members have an engaging pin, and
further wherein said first roller lifter has a first groove and
4 a second groove located on opposite sides of said first roller
lifter from each other and parallel to said longitudinal axis of
6 said first roller lifter, wherein one of said engaging pins of
said at least two interior members engages with said first
8 groove and an other of said engaging pins of said at least two
interior members engages with said second groove in said first
10 roller lifter to allow said movement of said first roller lifter
in said second direction.

9. An apparatus in an internal combustion engine having a
2 rotatable element that eccentrically moves at least one roller
lifter to alter the phasing of the at least one roller lifter
4 engaging with a cam, the apparatus comprising:

a constraining mechanism having at least one end member and
6 at least one interior member connected to said at least one end
member;

8 at least one stationary block which slidably receives a one
of said at least one end member allowing fore-and-aft movement
10 of said constraining mechanism in cooperation with a first
roller lifter in a first direction; and

12 a spring biased against said at least one interior member;
wherein said spring and said at least one interior member
14 engage said first roller lifter to allow movement in a second
direction to said first direction such that when the rotatable
16 element eccentrically moves said first roller lifter, said first
roller lifter is prevented from rotating about a longitudinal
18 axis of said first roller lifter.

10. The apparatus according to claim 9 wherein said at
2 least one interior member engages at least one flat surface of
said first roller lifter to allow movement in said second
4 direction.

11. The apparatus according to claim 9 wherein said first
2 direction and said second direction range from being
substantially perpendicular to each other to an orientation not
4 too close to parallel such that the at least one roller lifter
becomes constrained from moving eccentrically while being
6 prevented from rotating about said longitudinal axis.

12. The apparatus according to claim 9 further comprising:
2 a second roller lifter aligned with said first roller
lifter; and

4 an additional interior member connected to said at least
one end member, wherein said additional interior member engages
6 a flat surface of said second roller lifter to allow movement in
said second direction, and said second roller lifter is
8 prevented from rotating about a longitudinal axis of said second
roller lifter.

13. A method for controlling the orientation of at least
2 one roller lifter in an internal combustion engine having a
rotatable element that eccentrically moves the at least one
4 roller lifter to alter the phasing of the at least one roller
lifter engaging with a cam, the method comprising:
6 (a) slidably receiving a constraining mechanism in at
least one stationary block, wherein said constraining mechanism
8 in cooperation with a first roller lifter is only allowed to
move fore-and-aft in a first direction;
10 (b) engaging at least two interior members of said
constraining mechanism with said first roller lifter, wherein
12 said first roller lifter is allowed to move in cooperation with
said constraining mechanism in a second direction to said first
14 direction;
(c) eccentrically moving in said first and second
16 directions said first roller lifter with the rotatable element
engaged with said first roller lifter; and
18 (d) preventing said first roller lifter from rotating
about a longitudinal axis of said first roller lifter through
20 the cooperation of said first roller lifter with said
constraining mechanism.

14. A method according to claim 13 wherein step (a)
2 further comprises:
slidably receiving a first end member of said constraining
4 mechanism in a first of said at least one stationary blocks; and
slidably receiving a second end member of said constraining
6 mechanism in a second of said at least one stationary blocks.

15. A method according to claim 13 wherein step (b)
2 further comprises:
engaging a first of said at least two interior members of
4 said constraining mechanism with a first flat surface of said
first roller lifter; and
6 engaging a second of said at least two interior members of
said constraining mechanism with a second flat surface of said
8 first roller lifter;

wherein said first flat surface and said second flat
10 surface are substantially parallel to each other.

16. A method according to claim 13 wherein said first
2 direction and said second direction range from being
substantially perpendicular to each other to an orientation not
4 too close to parallel such that the at least one roller lifter
becomes constrained from moving eccentrically while being
6 prevented from rotating about said longitudinal axis.

17. A method according to claim 13 further comprising:
2 engaging at least two additional interior members of said
constraining mechanism with a second roller lifter aligned with
4 said first roller lifter, wherein said second roller lifter is
allowed to move in said second direction;
6 eccentrically moving in said first and second directions
said second roller lifter with the rotatable element engaged
8 with said second roller lifter; and
preventing said second roller lifter from rotating about a
10 longitudinal axis of said second roller lifter through the
cooperation of said second roller lifter with said at least two
12 additional interior members of said constraining mechanism.

18. A method according to claim 13 wherein step (b)
2 further comprises:
engaging a slot within a first of said at least two
4 interior members of said constraining mechanism with a first
locating pin on said first roller lifter; and
6 engaging a slot within a second of said at least two
interior members of said constraining mechanism with a second
8 locating pin on said first roller lifter;
wherein said first locating pin and said second locating
10 pin extend from opposite sides of said first roller lifter.

19. A method according to claim 13 wherein step (b)
2 further comprises:

engaging an engaging pin within a first of said at least
4 two interior members of said constraining mechanism with a first
groove on said first roller lifter; and
6 engaging an engaging pin within a second of said at least
two interior members of said constraining mechanism with a
8 second groove on said first roller lifter;
wherein said first groove and said second groove are
10 located on opposite sides of said first roller lifter and
parallel to said longitudinal axis of said first roller lifter.

20. A method for controlling the orientation of at least
2 one roller lifter in an internal combustion engine having a
rotatable element that eccentrically moves the at least one
4 roller lifter to alter the phasing of the at least one roller
lifter engaging with a cam, the method comprising:
6 (a) slidably receiving a constraining mechanism in at
least one stationary block, wherein said constraining mechanism
8 in cooperation with a first roller lifter is only allowed to
move fore-and-aft in a first direction;
10 (b) engaging at least one interior member of said
constraining mechanism with said first roller lifter;
12 (c) biasing a spring against said at least one interior
member, wherein said first roller lifter is allowed to move in
14 cooperation with said constraining mechanism in a second
direction to said first direction;
16 (d) eccentrically moving in said first and second
direction said first roller lifter with a rotatable element
18 engaged with said first roller lifter; and
(e) preventing said first roller lifter from rotating
20 about a longitudinal axis of said first roller lifter through
the cooperation of said first roller lifter with said
22 constraining mechanism.

21. A method according to claim 20 wherein step (a)
2 further comprises:
slidably receiving a first end member of said constraining
4 mechanism in a first of said at least one stationary blocks; and
slidably receiving a second end member of said constraining
6 mechanism in a second of said at least one stationary blocks.

22. A method according to claim 20 wherein step (b)
2 further comprises:
engaging said at least one interior member of said
4 constraining mechanism with a flat surface of said first roller
lifter.

23. A method according to claim 20 wherein said first
2 direction and said second direction range from being
substantially perpendicular to each other to an orientation not
4 too close to parallel such that the at least one roller lifter
becomes constrained from moving eccentrically while being
6 prevented from rotating about said longitudinal axis.

24. A method according to claim 20 further comprising:
2 engaging at least one additional interior member of said
constraining mechanism with a second roller lifter aligned with
4 said first roller lifter, wherein said second roller lifter is
allowed to move in said second direction;
6 eccentrically moving in said first and second directions
said second roller lifter with the rotatable element engaged
8 with said second roller lifter; and
preventing said second roller lifter from rotating about a
10 longitudinal axis of said second roller lifter through the
cooperation of said second roller lifter with said at least one
12 additional interior member of said constraining mechanism.

25. An apparatus in an internal combustion engine having a
2 rotatable element that eccentrically moves at least one roller
lifter to alter the phasing of the at least one roller lifter
4 engaging with a cam, the apparatus comprising:
a first constraining mechanism having a deformable member,
6 said deformable member further comprising:
a first end which pushes against a flat surface of a first
8 roller lifter;
wherein said constraining mechanism allows fore-and-aft
10 movement of said first roller lifter in a first direction
coincident with the deflection of said deformable member, and
12 allows movement of said first roller lifter in a second
direction to said first direction such that when the rotatable
14 element eccentrically moves said first roller lifter, said first
roller lifter is prevented from rotating about a longitudinal
16 axis of said first roller lifter.

26. The apparatus according to claim 25 wherein said first
2 constraining mechanism further comprises:
a base; and
4 a second end of said deformable member attached to said
base;
6 wherein said base is attached to the internal combustion
engine.

27. The apparatus according to claim 25 wherein said first
2 direction and said second direction range from being
substantially perpendicular to each other to an orientation not
4 too close to parallel such that the at least one roller lifter
becomes constrained from moving eccentrically while being
6 prevented from rotating about said longitudinal axis.

28. The apparatus according to claim 25 further
2 comprising:
a second roller lifter aligned with said first roller
4 lifter; and

6 a second constraining mechanism having a deformable member
6 having a first end which pushes against a flat surface of said
second roller lifter;
8 wherein said second constraining mechanism allows fore-and-
aft movement of said second roller lifter in said first
10 direction coincident with the deflection of said deformable
member, and allows movement of said second roller lifter in said
12 second direction such that when the rotatable element
eccentrically moves said second roller lifter, said second
14 roller lifter is prevented from rotating about a longitudinal
axis of said second roller lifter.

29. The apparatus according to claim 28 wherein said
2 second constraining mechanism further comprises:
a base; and
4 a second end of said deformable member attached to said
base;
6 wherein said base is attached to the internal combustion
engine.

30. A method for controlling the orientation of at least
2 one roller lifter in an internal combustion engine having a
rotatable element that eccentrically moves the at least one
4 roller lifter to alter the phasing of the at least one roller
lifter engaging with a cam, the method comprising:
6 (a) attaching a first constraining mechanism to the
internal combustion engine;
8 (b) engaging a first end of a deformable member of said
first constraining mechanism with a flat surface of a first
10 roller lifter, wherein said first roller lifter, in cooperation
with said first constraining mechanism is allowed to move fore-
12 and-aft in a first direction coincident with the deflection of
said deformable member, and is allowed to move in a second
14 direction to said first direction;
(c) eccentrically moving in said first and second
16 directions said first roller lifter with the rotatable element
engaged with said first roller lifter; and
18 (d) preventing said first roller lifter from rotating
about a longitudinal axis of said first roller lifter through
20 the cooperation of said first roller lifter with said first
constraining mechanism.

31. A method according to claim 30 wherein step (a)
2 further comprises:
attaching a base of said first constraining mechanism to
4 the internal combustion engine; and
attaching a second end of said deformable member of said
6 first constraining mechanism to said base.

32. A method according to claim 30 wherein said first
2 direction and said second direction range from being
substantially perpendicular to each other to an orientation not
4 too close to parallel such that the at least one roller lifter
becomes constrained from moving eccentrically while being
6 prevented from rotating about said longitudinal axis.

33. A method according to claim 30 further comprising the
2 steps of:

(e) repeating steps (a) through (d) for a second
4 constraining mechanism having a first end of a deformable member
engaged with a flat surface of a second roller lifter.

34. A method according to claim 33 further comprising:

2 attaching a base of said second constraining mechanism to
the internal combustion engine; and

4 attaching a second end of said deformable member of said
second constraining mechanism to said base.